What is claimed is:

1.   A method of working an optical element for producing an

optical element having a microscopic pattern comprising the

      step of drawing a pattern, corresponding to an optical

element, for forming a specified pattern on a base material

including a layer on which a pattern is to be drawn, wherein

      said layer of pattern drawing object has a curved

surface, and said specified pattern is drawn by the

application of an electron beam to said layer of pattern

drawing object.

2.   A method of working an optical element as set forth in

claim 1, wherein said specified pattern is formed by a

control of the exposure energy quantity of an electron beam.

3.   A method of working an optical element as set forth in

claim 2, wherein the depth of working is varied by the

aforesaid control of the exposure energy quantity of an

electron beam.

4.   A method of working an optical element as set forth in

claim 3, wherein the aforesaid exposure energy quantity of an

electron beam is controlled in such a way as to make the
depth of working vary within the depth of focus at a focus
position of an electron beam.

5.   A method of working an optical element as set forth in
claim 1, wherein the adjustment of the focus position of the
aforesaid electron beam with respect to the base material is
practiced by a control to move the height position of the
depth of focus through controlling an electron lens.

6.   A method of working an optical element as set forth in
claim 1, wherein the aforesaid electron beam is applied to a
resist layer on a base material.

7.   A method of working an optical element as set forth in
claim 1, further comprising the steps of

        forming a metal die on the basis of a base material on
which the aforesaid specified pattern has been drawn, and

        producing an optical element by carrying out injection
molding for said metal die.

8.   A method of working an optical element as set forth in
claim 1, further comprising

a development step to develop a base material to which
the aforesaid electron beam has been applied, and

an electroforming step to form a metal die by carrying
out electroforming processing on said base material which has
been developed.

9.   A method of working an optical element as set forth in
claim 8, wherein a base material is subjected to an etching
process before the aforesaid electroforming processing.

10.   A method of working an optical element as set forth in
claim 1, wherein pattern drawing by means of the aforesaid
electron beam is carried out independently for two base
materials, a first and a second metal dies formed by the
respective base materials are arranged facing to each other,
and an optical element having the aforesaid specified
patterns on the respective surfaces is produced by injection
molding.

11.   A method of working an optical element as set forth in
claim 10, wherein a polarized light splitting structure is
drawn on one base material and a diffractive grating
structure is drawn on the other base material.

12.   A method of working an optical element as set forth in claim 10, wherein a birefringence phase structure is drawn on one base material and a diffractive grating structure is drawn on the other base material.

13.   A method of pattern drawing for forming a specified pattern on a base material including a layer of pattern drawing object comprising the step of

      carrying out the drawing of said specified pattern by applying an electron beam to said layer of pattern drawing object, wherein

      said layer of pattern drawing object has a curved surface.

14.   A method of pattern drawing on a base material as set forth in claim 13, wherein the aforesaid specified pattern is formed by the control of exposure energy quantity of an electron beam.

15.   A method of pattern drawing on a base material as set forth in claim 14, wherein the aforesaid exposure energy quantity is controlled in accordance with the dose quantity.

16.   A method of pattern drawing on a base material as set
forth in claim 14, wherein the depth of working is varied by
a control of the aforesaid exposure energy quantity.

17.   A method of pattern drawing on a base material as set
forth in claim 16, wherein the aforesaid exposure energy
quantity of an electron beam is controlled in such a way as
to make the depth of working vary within the depth of focus
at a focus position of an electron beam with respect to the
base material.

18.   A method of pattern drawing on a base material as set
forth in claim 13, wherein the drawing of the aforesaid
specified pattern is carried out by relatively varying the
aforesaid focus position of an electron beam with respect to
the base material.

19.   A method of pattern drawing on a base material as set
forth in claim 18, wherein the aforesaid variation of the
focus position is carried out by the adjustment of the
aforesaid focus position of an electron beam.

20.   A method of pattern drawing on a base material as set forth in claim 19, wherein the aforesaid adjustment of the focus position of an electron beam is practiced by a control to move the height position of the depth of focus through controlling an electron lens.

21.   A method of pattern drawing on a base material as set forth in claim 20, wherein the aforesaid adjustment of the focus position of an electron beam is practiced by a control of the electric current value of an electron lens.

22.   A method of pattern drawing on a base material as set forth in claim 18, wherein the aforesaid variation of the focus position is carried out by a position adjustment through the movement of said base material.

23.   A method of pattern drawing on a base material as set forth in claim 18, wherein the aforesaid variation of the focus position is carried out by any one of the aforesaid adjustment of the focus position of an electron beam and the aforesaid position adjustment through the movement of said base material.

24.   A method of pattern drawing on a base material as set
forth in claim 23, further comprising a calculation step to
calculate at least the height position of the aforesaid
pattern drawing position.

25.   A method of pattern drawing on a base material as set
forth in claim 24, further comprising a pattern drawing step
to carry out pattern drawing for the aforesaid layer of
pattern drawing object while making the aforesaid position
adjustment.

26.   A method of pattern drawing on a base material as set
forth in claim 25, wherein the aforesaid pattern drawing step
includes a pattern drawing step to carry out pattern drawing
for one field, which is a unit space in a three-dimensional
standard coordinate system, on the basis of the aforesaid
pattern drawing position calculated, and a step to carry out,
after pattern drawing for the one field is done, pattern
drawing while carrying out the aforesaid calculation step and
position adjustment step again for another field.

27.   A method of pattern drawing on a base material as set
forth in claim 24, further comprising a thickness

distribution measurement step to measure the thickness
distribution of the base material beforehand.

28.   A method of pattern drawing on a base material as set
forth in claim 27, wherein, in the aforesaid calculation
step, at least the height position of the aforesaid pattern
drawing position is calculated on the basis of the aforesaid
thickness distribution of the base material.

29.   A method of pattern drawing on a base material as set
forth in claim 27, further comprising the step of measuring
the aforesaid thickness distribution of the base material
during the aforesaid application of an electron beam.

30.   A method of pattern drawing on a base material as set
forth in claim 27, further comprising a reference point
measurement step to measure the positions of a plurality of
reference points during the aforesaid application of an
electron beam, and a correction step to correct the aforesaid
thickness distribution on the basis of said positions of
reference points during the aforesaid application of an
electron beam.

31.   A method of pattern drawing on a base material as set
forth in claim 30, wherein the aforesaid thickness
distribution measurement step includes a step to calculate a
first three-dimensional standard coordinate system in respect
of said base material on the basis of the aforesaid plurality
of reference points on the base material measured beforehand,
and a step to calculate at least a first height position of
the aforesaid pattern drawing position with respect to said
first standard coordinate system, and the aforesaid
correction step includes a step to calculate a second three-
dimensional standard coordinate system in respect of said
base material on the basis of a plurality of reference points
measured when said base material is placed on a pattern
drawing stage, and a step to calculate a second height
position with respect to said second standard coordinate
system corresponding to said first height position as the
height position at said pattern drawing position of the
aforesaid electron beam.

32.   A method of pattern drawing on a base material as set
forth in claim 30, wherein the aforesaid reference point
measurement step includes a step to apply a light beam to
said base material from the direction approximately

perpendicular to the aforesaid electron beam, a step to
detect the intensity distribution of a light beam passing
through said base material on the basis of said light beam,
and a step to calculate the height position of said base
material on the basis of said intensity distribution of the
light beam.

33.   A method of pattern drawing on a base material as set
forth in claim 30, wherein the aforesaid reference point
measurement step includes a step of applying a first light
beam to said base material from the direction crossing the
aforesaid electron beam, and on the basis of said first light
beam, detecting a first intensity distribution of a light
beam reflected by a flat portion of said base material, a
step of applying a second light beam from the direction
approximately perpendicular to the aforesaid electron beam,
which is different from the direction of said first light
beam, to said base material, and on the basis of said second
light beam, detecting a second intensity distribution of a
light beam transmitted by said base material, and a step of
calculating the height position of said flat portion on the
basis of said first intensity distribution, and calculating
the height position of a point on a curved surface portion

projecting from said flat portion of said base material on
the basis of said second intensity distribution.

34.   A method of pattern drawing on a base material as set
forth in claim 24, wherein the aforesaid calculation step
includes a step to calculate a first three-dimensional
standard coordinate system in respect of said base material
on the basis of a plurality of reference points on said base
material measured beforehand, a step to calculate at least a
first height position of the aforesaid pattern drawing
position with respect to said first standard coordinate
system, a step to calculate a second three-dimensional
standard coordinate system in respect of said base material
on the basis of a plurality of reference points measured when
said base material is placed on a pattern drawing stage, and
a step to calculate a second height position with respect to
said second standard coordinate system corresponding to said
first height position as a height position at said pattern
drawing position of the aforesaid electron beam.

35.   A method of pattern drawing on a base material as set
forth in claim 24, wherein the aforesaid calculation step is

carried out during the aforesaid application of an electron
beam.

36. A method of pattern drawing on a base material as set
forth in claim 23, wherein the aforesaid position adjustment
step is carried out during the aforesaid application of an
electron beam.

37.   A method of pattern drawing on a base material as set
forth in claim 13, wherein the aforesaid electron beam is
applied to a resist layer on said base material.

38.   A method of pattern drawing on a base material as set
forth in claim 13, wherein the aforesaid specified pattern to
be formed on the aforesaid layer of pattern drawing object
corresponds to a specific pattern on an optical element.

39.   A method of pattern drawing on a base material as set
forth in claim 38, wherein the aforesaid specific pattern
includes a diffractive grating structure.

40.   A method of pattern drawing on a base material as set
forth in claim 39, wherein the aforesaid diffractive grating

structure is formed on the basis of a specified dose quantity
distribution corresponding to the scanning position.

41.   A method of pattern drawing on a base material as set
forth in claim 40, wherein the characteristic of the
aforesaid dose quantity distribution is defined beforehand.

42.   A method of pattern drawing on a base material as set
forth in claim 40, wherein the characteristic of the
aforesaid dose quantity distribution is one that is derived
in accordance with the angle of inclination of a slope on the
aforesaid curved surface portion.

43.   A method of pattern drawing on a base material as set
forth in claim 38, wherein the aforesaid specific pattern
includes a pattern for reducing surface reflection.

44.   A method of pattern drawing on a base material as set
forth in claim 43, wherein, in forming concave and convex
portions for the aforesaid pattern for reducing surface
reflection, the dose quantity distribution against scanning
position including an additional dose quantity for the
pertinent concave or convex portion is calculated on the

basis of the characteristic of the dose quantity
distribution, and pattern drawing on said base material is
carried out.

45.   A method of pattern drawing on a base material as set
forth in claim 44, wherein the characteristic of the
aforesaid dose quantity distribution is defined beforehand.

46.   A method of pattern drawing on a base material as set
forth in claim 43, wherein the aforesaid specific pattern
includes a diffractive grating structure and the aforesaid
pattern for reducing surface reflection.

47.   A method of pattern drawing on a base material as set
forth in claim 46, wherein at least one blaze unit having a
width of the pitch of a diffractive grating is formed with a
tilt on the aforesaid curved surface portion of the base
material, and concave and convex portions for reducing
surface reflection are formed for said one blaze unit.

48.   A method of pattern drawing on a base material as set
forth in claim 47, wherein the characteristic of the
aforesaid dose quantity distribution is derived in accordance

with the angle of inclination of a slope on the aforesaid
curved surface.

49.   A method of pattern drawing on a base material as set
forth in claim 47, wherein at least one blaze unit having a
width of the pitch of the aforesaid diffractive grating
comprises a side wall portion rising up on said base material
at an end position of said blaze unit, and a slope portion
formed between neighboring side wall portions of said blaze
unit, and the aforesaid concave and convex portions are
formed in said slope portion.

50.   A method of pattern drawing on a base material as set
forth in claim 47, wherein the aforesaid concave and convex
portions are composed of a large number of hole portions
being tapered.

51.   A method of pattern drawing on a base material as set
forth in claim 50, wherein pattern drawing is done in such a
way as to make the ratio of the area of the hole portions to
the area of the aforesaid slope portion a specified
proportion.

52.   A method of pattern drawing on a base material as set

forth in claim 46, wherein at least two blaze units each

having a width of the pitch of the aforesaid diffractive

grating comprise a side wall portion rising up at one end

position of said blaze unit and a slope portion formed

between the neighboring side walls each, and the aforesaid

reflection reducing structure is formed in such a way as to

reduce the reflection of a light beam entering said slope

portion or emerging from said slope portion.

53.   A method of pattern drawing on a base material as set

forth in claim 46, further comprising the steps of

      carrying out pattern drawing for the aforesaid curved

surface portion of said base material on the basis of the

dose quantity distribution against scanning position at the

time of forming at least one blaze unit of a diffractive

grating with a tilt on the curved surface portion of said

base material, and

      carrying out pattern drawing of the aforesaid concave

and convex portions on the basis of the dose quantity

distribution for the pertinent concave and convex portion, at

the time of forming concave and convex portions for reducing

surface reflection for said blaze unit of said diffractive
grating.

54.   A method of pattern drawing on a base material as set
forth in claim 43, wherein the aforesaid reflection reducing
structure is composed of a plurality of concave and convex
portions having a function of structural birefringence.

55.   A method of pattern drawing on a base material as set
forth in claim 43, wherein the aforesaid reflection reducing
structure comprises a plurality of hole portions.

56.   A method of pattern drawing on a base material as set
forth in claim 55, wherein each of the aforesaid hole
portions has a shape being tapered towards the depth
direction.

57.   A method of pattern drawing on a base material as set
forth in claim 55, wherein the aforesaid hole portions are
formed to have the respective openings with a diameter of an
order of sub-micron.

58.   A method of pattern drawing on a base material as set forth in claim 43, wherein the aforesaid reflection reducing structure has a structure to reduce the reflection of a light beam being incident or outgoing.

59.   A method of pattern drawing on a base material as set forth in claim 38, wherein the aforesaid specific pattern includes a polarized light splitting structure.

60.   A method of pattern drawing on a base material as set forth in claim 59, wherein the aforesaid polarized light splitting structure has a nearly concave and convex shape in a cross-section and has an approximately circular shape in the plan.

61.   A method of pattern drawing on a base material as set forth in claim 60, wherein, in the aforesaid polarized light splitting structure, a plurality of a first convex portion having a first width and a second convex portion having a second width which is different from said first width are formed at intervals.

62.   A method of pattern drawing on a base material as set
forth in claim 60, wherein, in the aforesaid polarized light
splitting structure, a first concave and convex portion
comprising a first convex portion having a first width and a
first concave portion having a second width which is
different from said first width being alternately formed, and
a second concave portion having a third width which is
different from said first width or second width are
alternately formed.

63.   A method of pattern drawing on a base material as set
forth in claim 59, wherein the aforesaid polarized light
splitting structure has such a structure as to split an
incident or outgoing light beam into at least two polarized
light components oscillating in the directions perpendicular
to each other in the plane crossing the progressing direction
of said light beam.

64.   A method of pattern drawing on a base material as set
forth in claim 59, wherein the aforesaid polarized light
splitting structure has such a structure as to split a
parallel bundle of rays into a plurality of bundles of rays

composed of P polarized light and S polarized light having
optical paths close to one another respectively.

65.   A method of pattern drawing on a base material as set
forth in claim 38, wherein the aforesaid specific pattern
includes a birefringence phase structure.

66.   A method of pattern drawing on a base material as set
forth in claim 65, wherein the aforesaid birefringence phase
structure has a concave and convex shape in a cross-section
and an approximately circular shape in the plan.

67.   A method of pattern drawing on a base material as set
forth in claim 66, wherein the aforesaid birefringence phase
structure is composed of concave portions having a first
width and convex portions having a second width which is
shorter than said first width being alternately formed.

68.   A method of pattern drawing on a base material as set
forth in claim 65, wherein the aforesaid birefringence phase
structure is such that produces a phase difference between
one linearly polarized light wave and the other linearly
polarized light wave of the incident or outgoing linearly

polarized light waves oscillating in the directions
perpendicular to each other respectively.

69.   A method of pattern drawing on a base material as set
forth in claim 65, wherein the aforesaid birefringence phase
structure is such that produces a phase difference at least
between a bundle of rays composed of a P polarized light and
a bundle of rays composed of S polarized light out of a
plurality of bundles of rays.

70.   A pattern drawing apparatus for forming a specified
pattern on a base material having a layer of pattern drawing
object comprising
      a moving means for moving the focus position of an
electron beam with respect to said base material in
accordance with said layer of pattern drawing object having a
curved surface, and
      an electron beam applying means for carrying out the
drawing of said specified pattern by applying an electron
beam to said layer of pattern drawing object.

71.   A pattern drawing apparatus as set forth in claim 70,
wherein

the aforesaid electron beam applying means comprises an electron lens for making variable the focus position of an electron beam emitted by said electron beam applying means, and

adjusts the electric current value of said electron lens in accordance with the pattern drawing position on the aforesaid base material, to control variably the focus position of said electron beam mentioned in the description of said moving means.

72.   A pattern drawing apparatus as set forth in claim 70, further comprising

a carrying table for placing a base material having a curved surface on the surface of pattern drawing object on which a pattern is to be drawn by the application of the aforesaid electron beam, and

a drive means for driving said carrying table, wherein

the focus position of said electron beam mentioned in the description of the aforesaid moving means is variably controlled by moving up and down said carrying table by said drive means in accordance with the pattern drawing position on said base material.

73.   A pattern drawing apparatus as set forth in claim 70,
wherein the aforesaid measuring means further comprises

a first optical system applying a first irradiation
light beam to the aforesaid base material from the oblique
direction and receiving a first light beam transmitted
through said base material,

a second optical system applying a second irradiation
light beam to said base material from the approximately
horizontal direction and receiving a second light beam
transmitted through said base material,

a measurement calculation means for calculating the
height position of the aforesaid pattern drawing position in
the flat portion of said base material, on the basis of a
first light intensity distribution detected by said first
optical system, and calculating the height position of said
pattern drawing position in the curved portion projecting
from said flat portion of said base material, on the basis of
a second light intensity distribution detected by said second
optical system.

74.   A pattern drawing apparatus as set forth in claim 70,
further comprising a second measuring means for measuring the
positions of reference points on the aforesaid base material

previously before said base material is placed in said apparatus.

75.   An optical element produced by a method as set forth in claim 1.

76.   An optical element as set forth in claim 75, comprising a diffractive grating structure on a curved surface.

77.   An optical element as set forth in claim 76, further comprising a pattern for reducing surface reflection on the aforesaid curved surface.

78.   An optical element as set forth in claim 77, wherein at least one blaze unit having a width of the pitch of a diffractive grating is formed with a tilt on the curved surface portion of the aforesaid base material, and concave and convex portions for reducing surface reflection are provided for said one blaze unit.

79.   An optical element as set forth in claim 78, wherein the aforesaid at least one blaze unit having a width of the pitch of a diffractive grating comprises a side wall rising

up at one end position of said blaze unit, and a slope
portion formed between neighboring side walls of said blaze
unit, and the aforesaid concave and convex portions are
provided on said slope portion.

80.   An optical element as set forth in claim 78, the
aforesaid concave and convex portions are composed of a large
number of hole portions being tapered.

81.   An optical element produced by a method as set forth in
claim 10.

82.   An optical element as set forth in claim 81, comprising
a diffractive grating structure on the surface of one side
and a polarized light splitting structure on the surface of
the other side.

83.   An optical element as set forth in claim 81, comprising
a diffractive grating structure on the surface of one side
and a birefringence phase structure on the surface of the
other side.

84.   An optical element as set forth in claim 81, comprising
a birefringence phase structure on the surface of one side
and a polarized light splitting structure on the surface of
the other side.

85.   A base material formed by a method as set forth in
claim 13.